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# EFFICIENT PAPER RECYCLING

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2013

# WHY RECYCLE PAPER ?

It makes sense from an economic and ecologic standpoint.

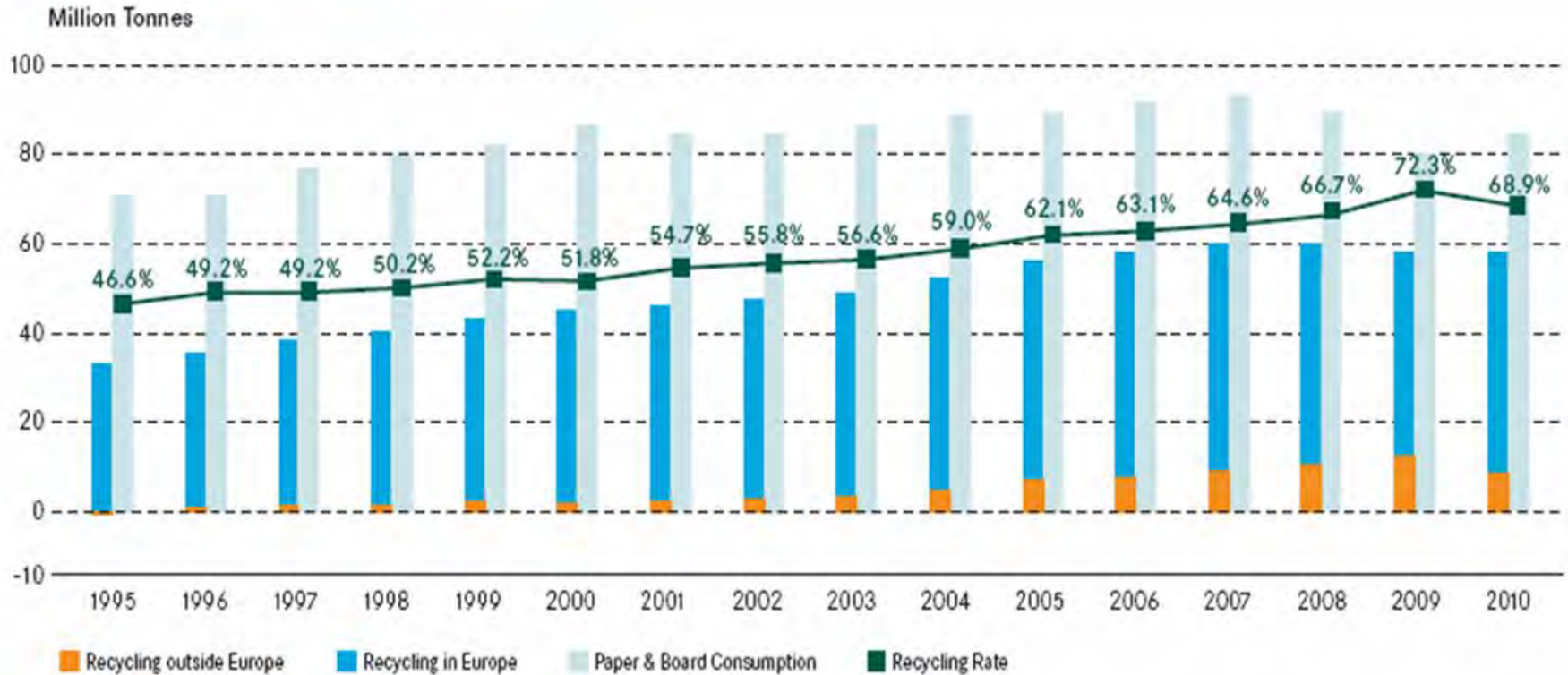
More than 60 million tonnes of used paper are collected in Europe.

Europe is the global leader in paper recycling:

- 90% of newspapers are printed on recycled paper
- 90% of corrugated boxes are made of recycled fibres
- 70.4% of consumed paper is sent for recycling
- 54% of the fibres used in new paper and board come from paper for recycling
- 2 tonnes of paper are recycled every second

# PAPER RECYCLING

## European Paper Recycling 1995-2010



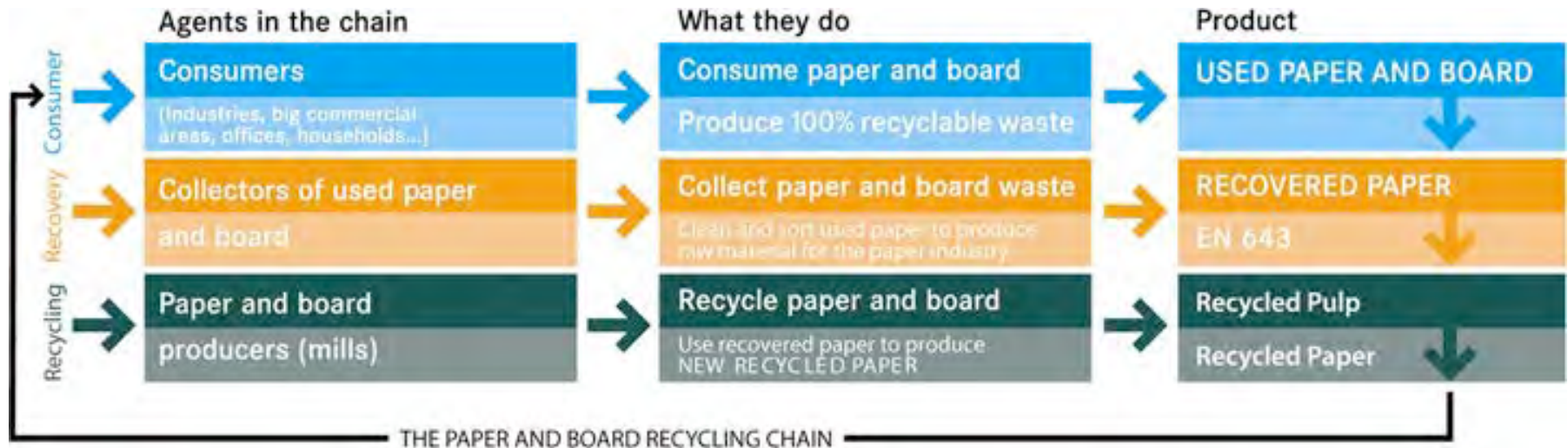
CEPI\_Key Statistics 2011.pdf

# PAPER RECYCLING

The theoretical maximum collection rate is around 81%.

The share of non-collectable and non-recyclable paper is estimated to be 19% of the total paper and board consumption (libraries, archives, sanitary paper, etc... )

## PAPER RECYCLING CHAIN



<http://www.paperforrecycling.eu/facts-figures/facts>



## RECYCLABILITY

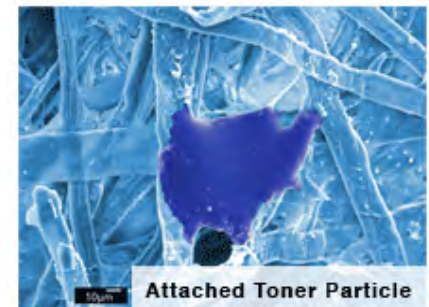
Characteristic of materials that still have useful physical or chemical properties after serving their original purpose and that can be reused or remanufactured into new product.

Printed products recyclability requirements:

- paper products have to be repulpable,
- adhesives have to be removable,
- for all white grades paper must be also deinkable.

## DEINKABILITY

Ability of a printed product to be deinked – removing ink and/or toner from a printed product to a high extent. It shall also restore, as well as possible the optical properties of unprinted product.



# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

## DEINKABILITY

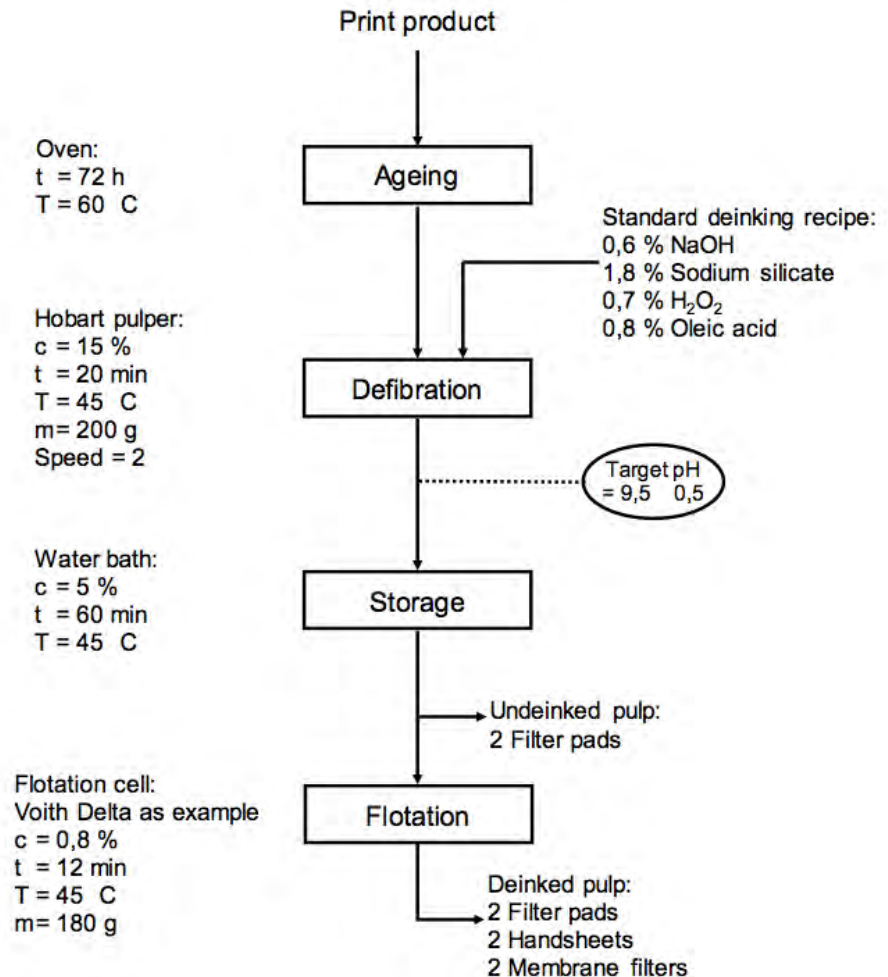
### INGEDE Method 11

#### Quality parameters:

- Luminosity
- Colour shade
- Dirt specks

#### Process parameters:

- Ink elimination
- Filtrate darkening



# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

## Threshold values of deinkability scores

Parameter	Y	a*	A <sub>50</sub>	A <sub>250</sub>	IE	ΔY
	[Points]	[-]	[mm <sup>2</sup> /m <sup>2</sup> ]	[mm <sup>2</sup> /m <sup>2</sup> ]	[%]	[Points]
Lower threshold	47	-3.0			40	
Upper threshold		2.0	2000	600		18

Y – luminosity of deinked pulp; a\* – colour of deinked pulp on green-red axis; A<sub>50</sub> – dirt particle area of all particles larger than 50 μm; A<sub>250</sub> – dirt particle area of all particles larger than 250 μm; IE – ink elimination; ΔY – filtrate darkening

## Target values of deinkability scores

Category of print product	Y	a*	A <sub>50</sub>	A <sub>250</sub>	IE	ΔY
	[Points]	[-]	[mm <sup>2</sup> /m <sup>2</sup> ]	[mm <sup>2</sup> /m <sup>2</sup> ]	[%]	[Points]
Newspapers	≥ 60	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Magazines, uncoated	≥ 65	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Magazines, coated	≥ 75	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 75	≤ 6
Stationery (Y of base paper ≤ 75)	≥ 70	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 70	≤ 6
Stationery (Y of base paper > 75)	≥ 90	≥ -2.0 to ≤ +1.0	≤ 600	≤ 180	≥ 80	≤ 6

# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

Test criteria for deinkability

Objectives	Evaluated Parameters
High Reflection	Luminosity Y of Deinked Pulp
High Optical Cleanliness	Dirt Area A of Deinked Pulp (in two size class categories >50 & >250)
No Color Shade	a* of Deinked Pulp
High Ink Removal	Ink Elimination IE
No Discoloration of Process Water	Filtrate Darkening $\Delta Y$

Quality Parameters

Process Parameters

Putz, H.-J., Voß, D.: Recyclability Assessment – the Chance to develop EcoPaper Products

<http://www.ecopaperloop.eu/en/events/2012-11-epw.html>



# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

Rating of  
Deinkability scores

Score	Evaluation of Deinkability
71 to 100 Points	Good
51 to 70 Points	Fair
0 to 50 Points	Tolerable
Negative (failed to meet at least one treshold)	Not suitable for deinking



Handsheets of deinked pulp:  
flexographic,  
offset,  
digitally printed.

Faul, A. M.: Quality requirements in graphic paper recycling. Cellulose Chem. Technol., 44 (10), 2010, 451-460

# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

## REMOVABILITY OF ADHESIVE APPLICATIONS

### INGEDE Method 12

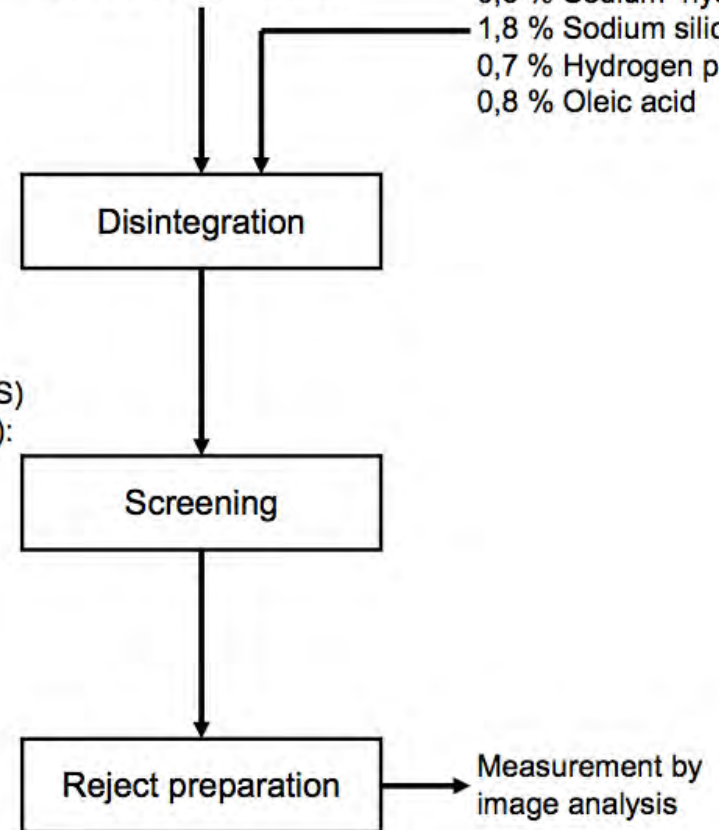
Macrosticky  
quantification  
(relative frequency,  
area)

Virgin woodfree copy paper  
with  
adhesive application

Deinking chemicals:  
0,6 % Sodium hydroxide  
1,8 % Sodium silicate  
0,7 % Hydrogen peroxide  
0,8 % Oleic acid

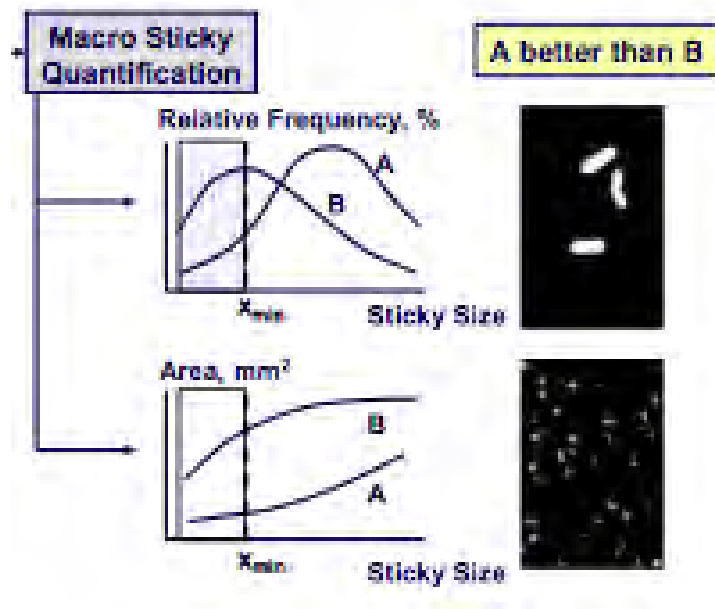
Hobart pulper:  
c = 15 %  
t = 30 min  
T = 45 °C  
m = 150 g b. d.  
Speed = 2

Somerville Classifier (S)  
or Haindl Classifier (H):  
t = 20 min (S)  
t = 5 min (H)  
m = 25 g (S)  
m = 50 g (H)  
slot width = 100 µm



# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

Particle size distribution of macrostickies



Objective	Evaluated Parameter
Sticky Potential	Total Macro-Sticky area < 2 000 $\mu\text{m}$ (after theoretical screening)
Fragmentation Behaviour	Share of Macro-Stickies < 2 000 $\mu\text{m}$

**Benchmark**

**Cut-off criteria**

# RECYCLABILITY EVALUATION FOR GRAPHIC PAPERS

## Rating of Removal scores

Score	Evaluation of removability
71 to 100 Points	Good
51 to 70 Points	Fair
0 to 50 Points	Tolerable
Negative (failed to meet the treshold)	Insufficient



# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

Packaging products recyclability requirements:

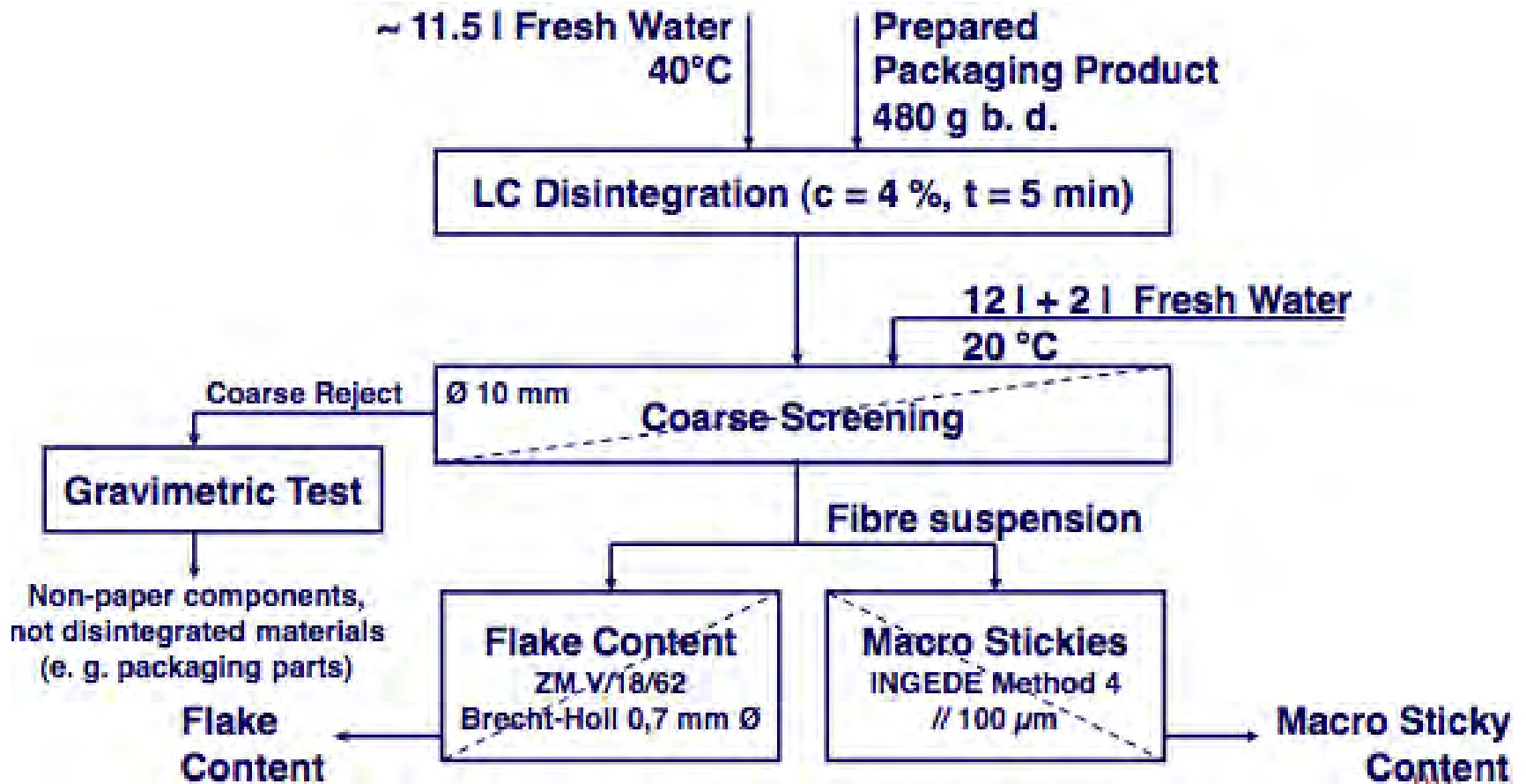
- Low fragmentation behaviour of adhesive applications
- Low flake content
- Low content of undesirable materials.

PMV Method for the Recyclability Evaluation of Packaging Products:

- Higher amount of sample material
- Objective evaluation of non-paper components
- Disintegration step with practical relevance
- Objective evaluation of sticky potential and sticky size distribution
- Possibility to evaluate other parameters as well.

# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

## DRAFT TEST METHOD



# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

## Major equipment



LC-Disintegration



Coarse Screening



Flake Content & Sticky Evaluation

Voß, D., Putz, H.-J.: Recyclability Seminar. Darmstadt, 22.-23. January 2013

# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

## Coarse screening

**Accept Coarse Screening:**  
Suspension for further  
evaluation (~ 24 l)



**Reject Coarse Screening:**  
Gravimetric Analysis





# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

## Typical coarse screening reject samples



# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS



← of flake content

Determination

Macro-sticky test



# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

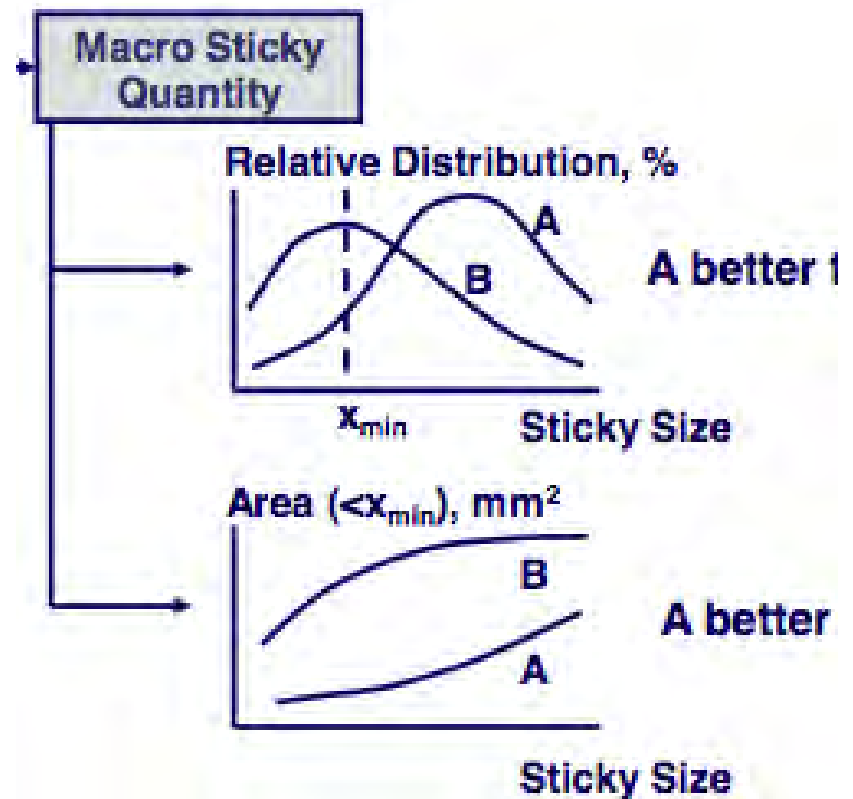
## Macrosticky content evaluation – INGEDE Method 4

### Reject preparation

Evaluation:

Rate of macrosticky particle area under  $3000 \mu\text{m}$ , %

Total macrosticky particle area under  $3000 \mu\text{m}$ ,  $\text{mm}^2$



# RECYCLABILITY EVALUATION FOR PACKAGING PRODUCTS

## Possible assessment

- Non-fiber components
- Flake content (for disintegration behaviour)
- Sticky content
  - e. g. Share of stickys  $< 3.000 \mu\text{m}$
  - Theoretical total sticky area after screening

Development of

Scoring System Analogue to Deinkability or Removability Score of graphic papers



# LEGISLATION

## The dual dimension of recycling:

- Standard EN 643 – used paper is recognized as raw material
- Law – recyclability is part of waste problem
- Directive 2001/77/EC – pulp and paper are declared as renewable energy resources
- Waste Framework directive 2008/98/EC – if paper for recycling fulfils End-of-waste criteria it is not declared as waste anymore.

## Important:

Other policies should not distort the market of separately collected paper. Supply side collection programs, mandatory and voluntary, have probably exerted the most significant and lasting influence on paper recovery and recycled fibre supply.

# PROJECT "EcoPaperLoop"

Innovhub-Stazioni Sperimentali per l'Industria

Paper Technology Consulting

Technical University of Darmstadt

Technical University of Dresden

Polish Packaging Research and Development Centre

Pulp and Paper Institute Ljubljana

University of Ljubljana

University of West Hungary

National Consortium for the Recovery and Recycling of  
Cellulose-based Packaging

Lombardy region



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# PROJECT "EcoPaperLoop"

## ECO DESIGN FOR THE ENHANCEMENT OF CENTRAL EUROPE PAPER BASED PRODUCTS RECYCLING LOOP

### What do we need in Central Europe

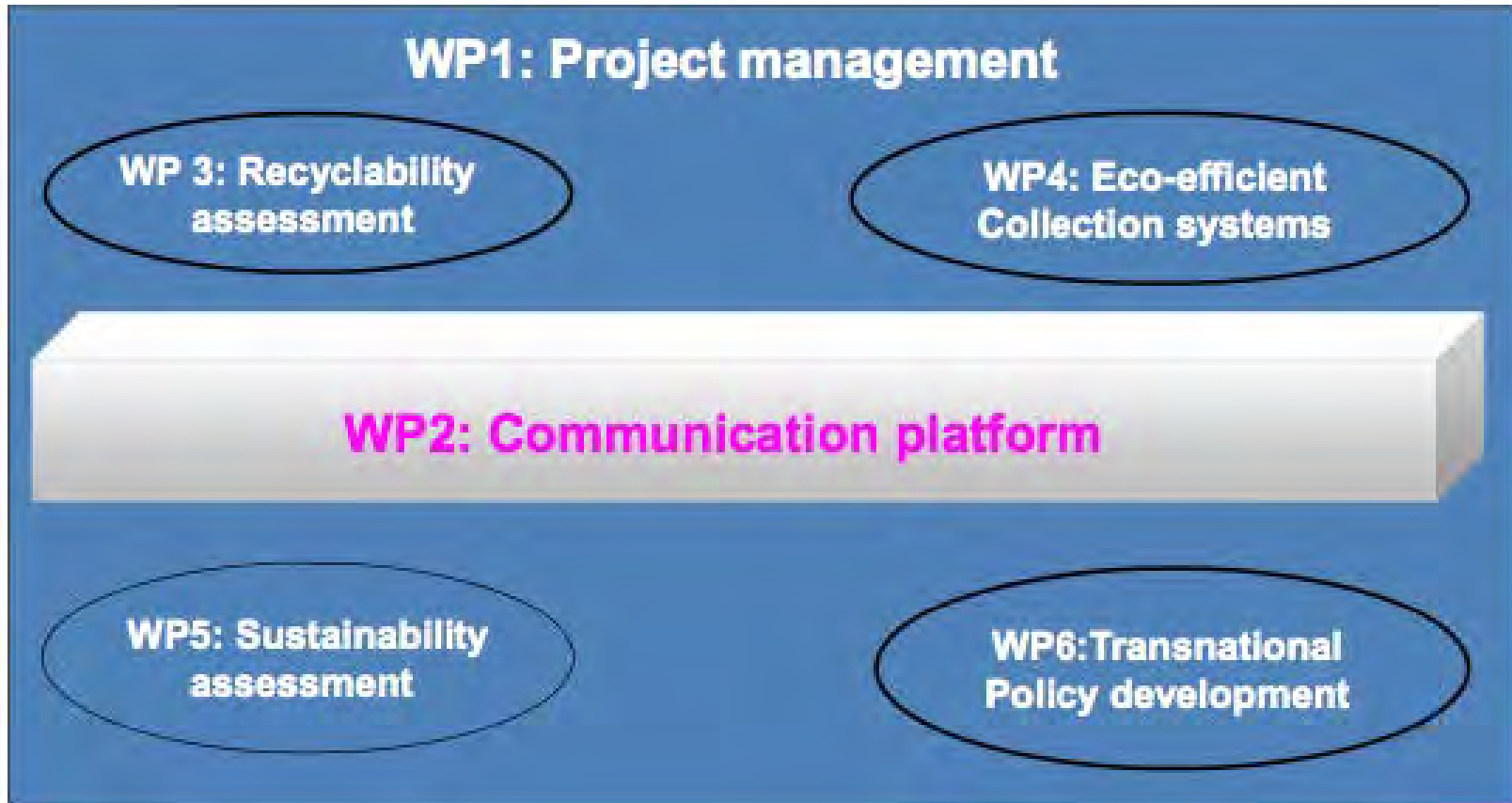
- Develop a clear picture of each region's status
- Develop common methods and practices
- Develop Communication platform to enhance awareness of recycling oriented eco-design and eco-collections
- Develop a sustainable transnational strategy for Central Europe management of paper for recycling

Elegir G.: Enhancing Paper Recycling.

<http://www.ecopaperloop.eu/en/events/2012-11-epw.html>

# PROJECT "EcoPaperLoop"

Project structure





# PROJECT "EcoPaperLoop"

## Main goals:

- Develop a common method on packaging recyclability.
- Create a large database on the recyclability of paper based products in Central Europe.
- Compare quality of paper for recycling versus different collection systems in the CE region. Deliver recommendation guidelines on sustainable paper collection strategies in the region.
- Enhance life cycle thinking in paper based products eco-design. Develop a software based tool calculator to support recycling oriented eco-design.
- Stimulate new policies to enhance quality of paper for recycling in the CE region.

# Thank you for your attention!

[www.ecopaperloop.eu](http://www.ecopaperloop.eu)

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